July 21, 1925. 1,546,460

C. ANDRADE, JR

DIFFERENTIAL

Filed Oct. 30, 1922 2 Sheets-Sheet 1

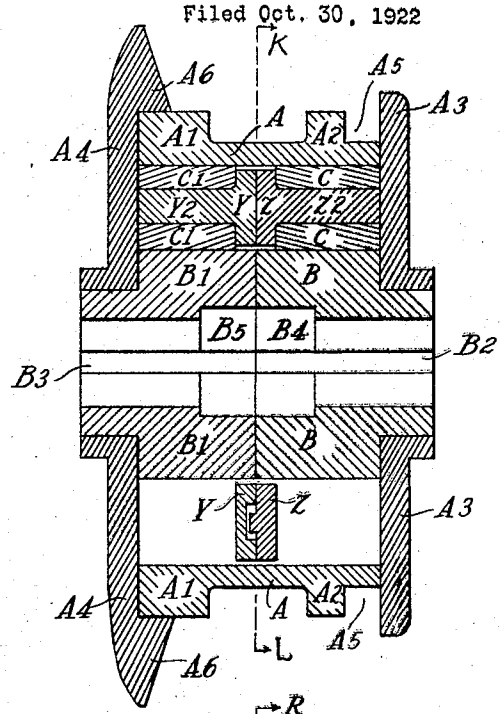


Fig. 1

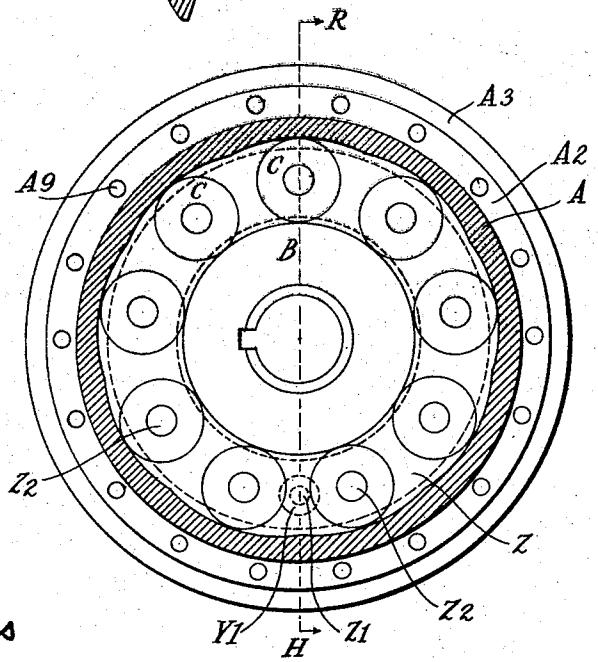


Fig. 2

Witness
Eleanor Knight
James W Bailey

INVENTOR.
Cipriano Andrade Jr

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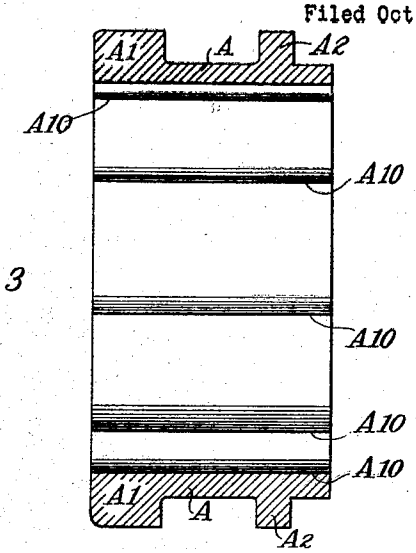


Fig. 3

Fig. 5

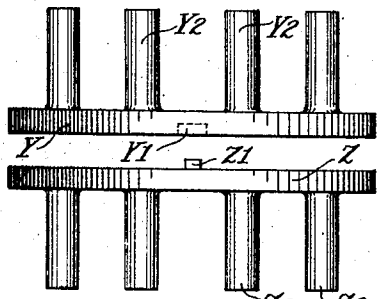


Fig. 6

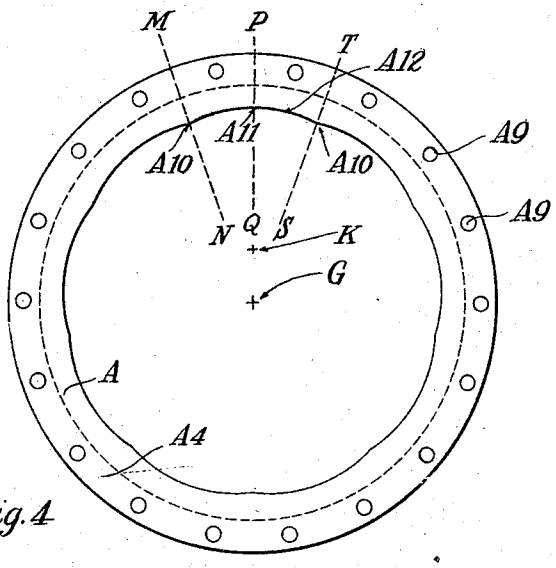


Fig. 4

Witness
Eleanor Knights
James W Bailey

INVENTOR.

Cipriano Andrade Jr.

Patented July 21, 1925. 1,546,460

UNITED STATES PATENT OFFICE.

CIPRIANO ANDRADE, JR., OF NEW YORK, N. Y.

DIFFERENTIAL.

Application filed October 30, 1922. Serial No. 597,707.

To all whom it may concern:

Be it known that I, CIPRIANO ANDRADE, Jr., a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a new and useful Differential, of which the following is a specification.

My invention relates to roller locking differentials; and the objects of my invention are, to provide certain improvements over the differentials shown in my two preceding applications, Serial No. 584,346 filed August 25, 1922, Patent No. 1,471,642, and Serial No. 585,843 filed September 2, 1922, Patent No. 1,472,452, as follows:

First: to hold all the locking members, which engage the same driven member, at a constant circumferential distance from one another at all times; second, to insure positive and simultaneous locking and unlocking of all the rollers on the same driven member at all times.

I retain these objects by the mechanism illustrated in the accompanying drawings, in which—

Fig. 1 is a longitudinal section elevation of my entire device on the line R H of Fig. 2; Fig. 2 is an end view of a part of the device taken on the line K L of Fig. 1; Fig. 3 is a longitudinal section elevation of the driving member A on the line R H of Fig. 2; Fig. 4 is an end view of driving member A; Fig. 5 is a bottom view of part Y of control member YZ; Fig. 6 is a bottom view of part Z of control member YZ.

Similar letters refer to similar parts throughout the several views.

A is the driving member, with circumferential reenforcements A^1 and A^2 to withstand the radial thrust of the roller locking members C and C^1 when in contact with the driven members B and B^1. A^3 is a flange with bolt holes. The bolts which pass through these holes also pass through the flange of the usual master gear, space for which is provided at A^5, and said bolts then enter corresponding taps A^9 in A^2. A^4 is a flange with bolt holes, the bolts for which enter corresponding holes A^9 in A^1. A^6 is an extension of flange A^4 to lock the outer periphery of A^1, and further reinforce it against radial extension. A^{10} are the ridges which mark the ends of the eccentric arcs A^{12}. A^{11} are the centers of said eccentric arcs. By reference to Fig. 4 the lines M N and T S mark the location of arc ends A^{10}, and the line P K marks the location of arc centres A^{11}.

G is the centre of the rotative motion of the driving member A, and K is the centre of the eccentric arc A^{12}. B is one of the driven members with keyway B^2 to engage the key on the end of one of the driven shafts, and recess B^4 to provide room for washers and other usual devices between the ends of the driven shafts. B^1 is the other driven member with keyway B^3 and recess B^5. C are roller locking members which engage driving member A and driven member B. Roller locking members C rotate on lugs Z^2 on part Z of control member YZ. C^1 are roller locking members which engage driving member A and driven member B^1. Roller locking members C^1 rotate on lugs Y^2 on part Y of control member YZ. Z^1 is a lug on part Z which enters recess Y^1 in part Y, and which permits a limited circumferential motion of Y with relation to Z.

In Fig. 2, to facilitate the identification of the various members, the control member YZ is shown wholly in dotted lines.

The prior art discloses differentials with a control member composed of two elements with limited circumferential play in relation to each other. But in all such devices in the prior art, there is no disclosure of any attempt to positively hold the rollers on each driven member at a constant circumferential distance from one another. The terms "constant circumferential distance" and "constant circumferential angle" as used herein and in the claims are interchangeable and mean a substantially constant circumferential angular distance, with only such circumferential clearance between the rollers and the control element as is common in mechanical construction, to permit easy surface motion between the adjoining parts, and at the same time to insure a positive and infallible simultaneous locking and unlocking of all the rollers which are controlled by each control element. This latter feature of my device is important, because in all the structures disclosed in the prior art, it is possible for one of the rollers to lock, while the others remain unlocked, which case an enormous radial thrust is developed by the one locked roller, which may indent or actually break the roller, or the driving member or the driven member, and which in any case will cause a rigid locking contact between the driving member and the driven member

either directly or through some third element, and this rigid locking contact renders the unlocking function difficult.

While my drawings disclose absence of direct circumferential contact between the driving member and the driven members, it will be understood that my invention covers and my device will function whether or not there is direct circumferential contact, or indirect circumferential contact or no circumferential contact between the driving member and the driven members.

The operation of my device is as follows:

It will be observed by reference to Figs. 1 and 2, that I have shown the roller locking members C and C^1 in contact both with driving member A and driven members B and B^1 while in a neutral position. This contact is not necessary in order to hold all the locking members, which engage the same driven member, at a constant circumferential distance from one another at all times, said result being achieved wholly by lugs Y^2 and Z^2 which are integral respectively with control parts Y and Z. Control member YZ can be used to perform this particular function in combination with a driving member, the centres of whose eccentric recesses exceed in radial distance from the periphery of the driven member, the diameter of the roller locking members, as in my said two pending applications, Serial Nos. 584,346 and 585,843.

One of the advantages of keeping all the roller locking members of each set at the same circumferential distance from one another is, that it distributes the radial outward thrust equally to all the eccentric recesses which operate on the same driven member.

One object of bringing all the roller locking members into constant contact with both the driving and the driven members, is to minimize the lost motion between the instant when the driving member starts to rotate and the instant when the roller locking members come into final locking contact with both the driving member and the driven member. The contact shown in Figs. 1 and 2 of the drawings is not so rigid as to preclude the roller locking members C from rotative motion against the surfaces of B and of A^{11}, nor to preclude the roller locking members C^1 from rotative motion against the surfaces of B^1 and A^{11}, when the parts are in the relative neutral position shown in Fig. 2. When, however, driving member A starts to rotate either clockwise or anticlockwise it will roll locking members C and C^1 a short distance away from A^{11}, thus changing their easy rotative contact into a rigid locking contact, and thereupon all the differential functions as fully shown and described in my said applications Nos. 584,346 and 585,843 become fully operative. It should be stated that the necessary slight movement of the roller locking members toward the driven members may be allowed for in any suitable way, for instance in the form of construction just described by mounting the rollers on the lugs with a sufficient amount of play.

I claim:

1. In a differential; a control member consisting of two elements adapted to limited circumferential motion relatively to one another, each element having lugs whose axes are parallel with the axis of the driven member; and roller locking members, each having a longitudinal bore which fits around the lugs on each of said elements, whereby the roller locking members on each element are held at the same circumferential angle from each other.

2. A differential comprising a driving member and a driven member, one of said members having a cylindrical locking surface with a multiplicity of arc portions eccentric thereto, the eccentric arc surface of each of said arc portions meeting the arc surface of its adjoining arc portion, rollers in the arc portions and a control element for the rollers having connections with the rollers, but without substantial lost motion between the rollers and control elements to compel said rollers to maintain a constant angular distance from one another.

3. A differential comprising driving and driven members, a control member consisting of two adjacent elements having roller axles rigidly attached thereto on opposite sides of the respective elements, each axle having snugly fitting thereon a locking roller, the distance between the surfaces of the rollers being less than the diameter of the rollers, means permitting said elements to have very limited circumferential motion relatively one to the other, the construction being such that there is no lost motion between a controlling member and its rollers, and the strain on the differential is distributed through a large number of rollers.

4. A differential comprising a driving member having locking surfaces extending from one side to the other of the driving member, a control member within the driving member consisting of two elements, rollers carried by each element and coacting means between the rollers and the elements preventing lost motion between the rollers and elements, means permitting a slight lost motion between the two elements, said rollers fitting within the beforementioned locking surfaces, the distance between the exterior surfaces of the rollers being less than the diameter of the rollers, and two driven members having cylindrical surfaces to contact with the surfaces of the rollers.

5. A differential comprising a driving member and a driven member, the driving

member having an interior cylindrical locking surface with a multiplicity of arc portions eccentric thereto extending from one side to the other of said driving member, the eccentric arc surface of each of said arc portions meeting the arc surface of its adjoining arc portions, hollow rollers in the arc portions, controlling elements for the rollers, each element having axes on which the rollers revolve, there being no substantial lost motion between the rollers and the control elements whereby said rollers are maintained at a constant angular distance from one another.

CIPRIANO ANDRADE, JR.

Witnesses:
ELEANOR HAIGHT,
JAMES W. BAILEY.